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ABSTRACT

The United States Training and Employment Service General Aptitude Test Battery (GATB), first published in 1947, has been included in a continuing program of research to validate the tests against success in many different occupations. The GATB consists of 12 tests which measure nine aptitudes: General Learning Ability; Verbal Aptitude; Numerical Aptitude; Spatial Aptitude; Form Perception; Clerical Perception; Motor Coordination; Finger Dexterity; and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, and a standard deviation of 20. Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, when combined, predict job performance. Cutting scores are set only for those aptitudes which aid in predicting the performance of the job duties of the experimental sample. The GATB norms described are appropriate only for jobs with content similar to that shown in the job description presented in this report. A description of the validation sample is also included. (AG)

FINAL REPORT

TECHNICAL REPORT

ON

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY

FOR

JEWELRY ASSEMBLER 6-72.333

B-407



U. S. Employment Service in
Cooperation with
California State Employment Service

U. S. DEPARTMENT OF LABOR
Bureau of Employment Security
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# STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY FOR JEWELRY ASSEMBLER 6-72.333

B-407

## Summary

The General Aptitude Test Battery, B-1002A, was administered to a sample of 55 applicants who were later employed as Jewelry Assembler 6-72.333 by the Josten Manufacturing Company, Santa Barbara, California. The criterion consisted of broad category supervisory ratings. On the basis of mean scores, correlations with the criterion, job analysis data, and their combined selective efficiency, Aptitudes P-Form Perception and M-Manual Dexterity were selected for inclusion in the test norms.

## GATB Norms for Jewelry Assembler 6-72.333 - B-407

Table I shows, for B-1001 and B-1002, the minimum acceptable score for each aptitude included in the test norms for Jewelry Assembler 6-72.333.

TABLE I

Minimum Acceptable Scores on B-1001 and B-1002 for B-407

| B-1001 | | | B-1002 | | |
|---|---|---|---|---|---|
| Aptitude | Tests | Minimum Acceptable Aptitude Score | Aptitude | Tests | Minimum Acceptable Aptitude Score |
| P | CB-1-A<br>CB-1-L | 80 | P | Part 5<br>Part 7 | 80 |
| M | CB-1-M<br>CB-1-N | 75 | M | Part 9<br>Part 10 | 75 |

## Effectiveness of Norms

The data in Table IV indicate that 9 of the 16 poor workers, or 56 percent of them, did not achieve the minimum scores established as cutting scores on the recommended test norms. This shows that 56 percent of the poor workers would not have been hired if the recommended test norms had been used in the selection process. Moreover, 36 of the 43 workers who made qualifying test scores, or 84 percent, were good workers.

TECHNICAL REPORT

## I. Problem

This study was conducted to determine the best combination of aptitudes and minimum scores to be used as norms on the General Aptitude Test Battery for the occupation of Jewelry Assembler 6-72.333.

## II. Sample

The GATB, B-1002A, was administered during the period October 1, 1956 to December 31, 1957, to approximately 100 applicants who were later employed as Jewelry Assembler 6-72.333 at the Josten Manufacturing Company in Santa Barbara, California. Applicants were screened by the Santa Barbara local office of the Department of Employment on the basis of an employer order and scheduled for testing by especially trained personnel in the local office. Selection was determined by the specifications on the employer order and the test scores were not considered in the referral process. The job order specified an open age range, no experience required, and at least a 9th grade education.

Approximately 85 of the tested applicants either were accepted, or accepted employment with the company after referral by the local office. Arrangements were made with the Plant Production Manager to obtain ratings on quantity and quality of performance of the new hires after they had been on the job a sufficient length of time to reach normal production.

Of the 85 hired, 10 terminated within too short a time to permit proper ratings, 13 were dropped from the sample because they were not performing comparable work, 6 were on the job too short a time to be rated when final ratings were picked up, and one was excluded because of a language handicap. This resulted in a final sample of 55 workers (38 women and 17 men).

Table II shows the means, standard deviations, ranges, and Pearson product-moment correlations (corrected for broad categories) with the criterion for age, education, and experience.

TABLE II

Means (M), Standard Deviations ($\sigma$), Ranges, and Pearson Product-Moment Correlations (Corrected for Broad Categories) with the Criterion ($c^r$) for Age, Education, and Experience

Jewelry Assembler 6-72.333
N = 55

| | M | $\sigma$ | Range | $c^r$ |
|---|---|---|---|---|
| Age (years) | 28.7 | 9.0 | 17-57 | -.376** |
| Education (years) | 11.1 | 1.8 | 7-16 | .348** |
| Experience (months) | 1.0 | 1.0 | 1 | |

**Significant at the .01 level

The significant negative correlation between the criterion and age indicates that there is a tendency for the younger workers to be more proficient on the job and/or that the supervisor was biased in favor of the younger workers.

The significant positive correlation between the criterion and education may indicate a bias on the part of the supervisor in favor of the better educated workers, or it may reflect a true relationship between job proficiency and education. The data in Table II indicate that this sample is suitable for test development purposes with respect to age, education, and experience.

## III. Job Description

Job Title: Jewelry Assembler 6-72.333

Job Summary: Performs one or more of the following operations in the manufacture and assembly of costume jewelry: Stamps out, anneals, and grinds gold metal blanks to form ring shanks or bezels. Cuts, rounds, welds, and prepares shanks for final rounding and filing. Files ring and places ring on pegboard ring sizer to determine correct size. Fuses initials and bezels to ring, and merges bezel edges with signet. Applies enamel to ring and cleans ring. Polishes outside and inside diameters of rings. Solders pegs to crests of rings and rivets pegs to inside surface of ring. Sets stones in rings.

Work Performed: Stamps out, anneals, and grinds gold metal blanks to form ring shanks or bezels: Picks up flat metal blank with right hand, positions in die holder in bed of pneumatic hammer, and depresses treadle of machine. Picks up cut-out shank from bed of machine at the end of machine cycle, places in metal tray, and repeats operation. Performs same operation to stamp out bezel part of ring.

Picks up metal tray of shanks with hand tongs and slides tray into atmospheric furnace to relieve internal strains caused by the hammering operation. Removes tray from furnace at specified time, sets aside, and repeats operation. Performs same operation to anneal bezel parts. Blanks are struck several times, each time requiring annealing before being struck again.

Inserts shank in die holder in bed of horizontal circular grinder with right hand, and lowers revolving grinding wheel to point of contact with shank by pulling down lever with left hand. Observes operation as bed of machine automatically feeds shank, longitudinally forward and backward under the grinding wheel. Pushes up lever to lift grinding wheel and removes shank. Visually inspects shank for smooth, even finish, performing re-work when necessary. Repeats operation on next shank. Performs same operation to grind bezels.

Cuts, rounds, welds, and prepares shanks for final rounding and filing: Sorts shanks according to style and cuts shank ends to correct size on metal cutting machine. Turns sizing knob until dial indicator is at

correct size reading, places blank in machine, and cuts required amounts off shank ends. Places shank in a depression in wooden block on bed of a multipress, inserts mandrel in chuck holder of press, and depresses foot pedal to start press. Mandrel gives repeated blows to shank as it is pulled under press, causing shank to turn up around mandrel, forming the first rough rounding of the ring.

Slips rounded ring over a steel mandrel sizer and pounds ring with a rawhide hammer until ring ends are joined. Takes ring in fingers and forces joint open on an anvil. Picks up small sliver of gold solder with tweezers and deposits in ring joint. Holds ring between two elliptical shaped rods of a welding machine to melt and secure solder to joint, being careful to remove ring when solder has just melted and is ready for fusion. Uses a grinding tool with a triangular shaped cutting head to cut out gold from sides of ring where thickness is not required.

Final rounds and files rings: Places "rough-rounded" rings over ring mandrels and pounds with rawhide hammer to "final-round" the ring. Files ring with regular hand file to smooth surface. Places ring on peg board ring sizer to determine correct size.

Charges the bezels: Picks up sliver of solder with tweezers and deposits solder on signet portion of ring; picks up properly matching bezel and lays on signet; clamps bezel to signet with spring clamp. From a pan containing initials in alphabetized compartments, picks up proper initials with tweezers and lays initials onto shoulder depressions in ring. Places ring on a holding rack. Slides filled rack in an oven which melts solder on underside of initials and bezels, and fuses initials and bezels to ring.

Merges bezel and signet: Holds ring with hands and fingers and pushes top portion of ring against a high speed carborundum cutting wheel, about $\frac{1}{4}$ inch in width, turning ring against the cutting wheel to blend or merge the bezel edges with signet.

Applies enamel to rings and cleans rings: Dips fine artist's brush in enamel and fills designated ring cavities by deftly and carefully stroking brush over cavity. Blots edge of cavity with blotter paper to remove water portion of enamel mix and prevent uneven setting of enamel. Strikes bottom of ring against bench to force enamel to bottom of cavity. Places ring in rack. Places filled rack in oven for baking. Operates a hand grinder to remove baked enamel that may be covering initials or numerals, bringing out the design evenly and cleanly.

Uses a light, careful touch so as not to remove any portion of initial or too much enamel. Cleans rings with acid, water, compressed air or scratch brushing, as necessary.

Polishes outside and inside diameters of rings: Removes surface scratches, abrasions, and blemishes from rings, using polishing wheels and tripoli polishing compound. Holds inside diameter of ring against an open-end revolving emery rod impregnated with tripoli; brushes outside diameter of ring by holding ring surface against revolving bristle brushes; polishes ring surfaces by holding ring against small and large felt polishing wheels;

buffs rings against a buffing wheel. Obtains a high or bright polish on ring surfaces by holding rings against a series of emery rods, felt polishing wheels, and bristle brushes, using rouge polishing compound.

Solders pegs to crests of rings and rivets pegs to inside surface of ring: Picks up small sliver of gold solder with tweezers, dips in flux, and positions on crest. Picks up two short lengths of fourteen carat gold pegs with tweezers and inserts pegs into end of holding rod. Turns holding rod to a vertical position so that pegs are at bottom of rod and positions protruding pegs onto soldering points of crests. Applies flame of small acetylene torch at 1430 degrees fahrenheit to crest, deftly and slowly moving torch flame to and from crest surface to maintain this approximate temperature, and solders pegs to crest. Operates a riveting machine to rivet pegs of crests to inside surface of ring. Crest may go through two or three operations from pegging, such as enameling, bright cutting and polishing, before it is riveted to signet.

Sets stones in rings: Reams a seat for the ring stone along the side edges of bezel, using a flexible grinder and various sized dental drills. Seats stone in bezel by hand. Crimps end-tabs of bezel over stone with a hand crimper and pounds down end-tabs with small punch and hammer. Files marks made by crimping with a narrow hand file and cuts off burrs made by filing with a small hand graver.

## IV. Experimental Battery

All the tests of the GATB, B-1002A, were administered to the sample group.

## V. Criterion

The criterion consisted of broad category ratings made by the production manager. Ratings were made on those persons who left the plant, provided they had been on the job a sufficient length of time for the production manager to judge their performance in terms of quantity and quality of production. Ratings on those workers who remained with the company were assigned on the same basis at the completion of their training period. The training period was estimated to be about 30 days. Only one set of ratings was available for the sample, since it was not possible to rerate those persons who had left the company. Each worker was placed in one of three broad categories: the A (above average) group with 15 workers, the B (average) group with 24 workers, and the C (below average) group with 16 workers. For statistical purposes the broad category ratings of A, B, and C were converted to quantitative scores of 62, 50, and 38, respectively.

## VI. Statistical and Qualitative Analyses

### A. Statistical Analysis:

Table III shows the means, standard deviations, and Pearson product-moment correlations (corrected for broad categories) with the criterion for the aptitudes of the GATB. The means and standard deviations of the aptitudes are comparable to general working population norms with a mean of 100 and a standard deviation of 20.

TABLE III

Means (M), Standard Deviations ($\sigma$), and Pearson Product-Moment Correlations (Corrected for Broad Categories) with the Criterion ($\sigma^r$) for the Aptitudes of the GATB

Jewelry Assembler 6-72.333
N = 55

| Aptitudes | M | $\sigma$ | $\sigma^r$ |
|---|---|---|---|
| G-Intelligence | 93.2 | 14.8 | .515** |
| V-Verbal Aptitude | 96.7 | 14.4 | .366** |
| N-Numerical Aptitude | 87.3 | 15.1 | .513** |
| S-Spatial Aptitude | 98.5 | 20.8 | .297* |
| P-Form Perception | 95.4 | 15.3 | .519** |
| Q-Clerical Perception | 98.5 | 15.0 | .592** |
| K-Motor Coordination | 101.4# | 14.4 | .062 |
| F-Finger Dexterity | 108.8# | 18.0 | .021 |
| M-Manual Dexterity | 101.8# | 18.0 | .197 |

**Significant at the .01 level
*Significant at the .05 level
#Highest mean scores

B. Qualitative Analysis:

The statistical results were interpreted in the light of the job analysis data. The job analysis indicated that the following aptitudes measured by the GATB appear to be important for this occupation.

Spatial Aptitude (S) and Form Perception (P) - required to perceive proper forming and rounding of ring shanks; to sort shanks to size, and to cut shank ends to correct size; to align bezels to signets and initials to ring shoulders, and to properly position pegs to crest. Also required to visually inspect for flaws and scratches on ring surfaces.

Motor Coordination (K), Finger Dexterity (F), and Manual Dexterity (M) - required to handle ring shanks, bezels, small tweezers, punches, and precious stones. Also required to operate pneumatic press, to handle ring mandrels, hammers, and gravers and to operate grinding machines.

C. Selection of Test Norms:

Based on the quantitative and qualitative evidence cited above, Aptitudes S, P, K, F, and M warranted further consideration for inclusion in the test norms. The evidence for each of these aptitudes is indicated below.

| Aptitude | Relatively High Mean Score | Significant Correlation with the Criterion | Importance Indicated by Qualitative Analysis |
|---|---|---|---|
| S | | X | X |
| P | | X | X |
| K | X | | X |
| F | X | | X |
| M | X | | X |

Although Aptitudes G, V, N, and Q show significant correlations with the criterion, these aptitudes were not considered further for inclusion in the test norms because there was no other quantitative or qualitative evidence of significance.

Various combinations of Aptitudes S, P, K, F, and M with appropriate cutting scores were selected as trial norms. The relationship between each set of trial norms and the criterion (dichotomized as indicated in Section VII was determined.

A comparison of the results showed that norms consisting of P-80 and M-75 for B-1002 and equivalent norms of P-80 and M-75 for B-1001 had better selective efficiency for this sample than any other combination of aptitudes and cutting scores.

Aptitude P with a cutting score of 80 had the highest selective efficiency for the sample and the addition of Aptitude M with a cutting score of 75 reduced the selective efficiency slightly as a result of failing one more worker in the high criterion group. In view of these circumstances, B-1002 norms consisting of P-80 and M-75 are recommended because the use of P-80 alone would not be sufficient for the initial screening of applicants; there is both quantitative and qualitative evidence supporting inclusion of Aptitude M in the norms; and these norms do have better selective efficiency than any other combination of aptitudes and cutting scores.

In test development studies an attempt is made to develop a set of norms such that the cutting score for each aptitude included in the norms will be set at a five-point score level close to one standard deviation below the aptitude mean of the experimental sample. Adjustments of cutting scores from one standard deviation below the mean are made to effect better selective efficiency of the norms. In this study the aptitude cutting scores are each within 10 points of one standard deviation below the aptitude mean of the sample.

## VII. Concurrent Validity of Norms

For the purpose of computing the tetrachoric correlation coefficient between the test norms and the criterion and applying the Chi Square test, the criterion was dichotomized with those workers rated as Above Average and Average placed in the high criterion group, and with those rated as Below Average placed in the low criterion group. This resulted in 16 of the 55 workers, or 29 percent of the sample, being placed in the low criterion group.

Table IV shows the relationship between test norms consisting of Aptitudes P and M with critical scores of 80 and 75 respectively, and the dichotomized criterion for Jewelry Assembler 6-72.333. Workers in the high criterion group have been designated as "good workers," and those in the low criterion group as "poor workers."

TABLE IV

Relationship between Test Norms Consisting of Aptitudes P and M with Critical Scores of 80 and 75 Respectively, and the Criterion for Jewelry Assembler 6-72.333

N = 55

| | Non-Qualifying Test Scores | Qualifying Test Scores | Total |
|---|---|---|---|
| Good Workers | 3 | 36 | 39 |
| Poor Workers | 9 | 7 | 16 |
| Total | 12 | 43 | 55 |

$r_{tet} = .80$ $\quad X^2 = 12.965$

$\sigma_{r_{tet}} = .25$ $\quad P/2 < .0005$

The data in the above table indicate a significant relationship between the test norms and the criterion for the sample.

## VIII. Conclusions

On the basis of mean scores, correlations with the criterion, job analysis data, and their combined selective efficiency, Aptitudes P and M with minimum scores of 80 and 75 respectively, are recommended as B-1002 norms for the occupation of Jewelry Assembler 6-72.333. The equivalent B-1001 norms consist of P-80 and M-75.

## IX. Determination of Occupational Aptitude Pattern

When the specific test norms for an occupation include two aptitudes, only those occupational aptitude patterns which include those two aptitudes with cutting scores that are within 10 points of the cutting scores established for the specific norms are considered for that occupation. Three of the existing 23 occupational aptitude patterns meet these criteria for this study. These occupational aptitude patterns and their B-1002 norms are OAP-13, S-75, P-75, M-75; OAP-15, P-85, K-80, M-80; OAP-16, P-75, F-80, M-80. The selective efficiency of each of these OAP's for this sample was determined by means of the tetrachoric correlation technique. A significant relationship was obtained between each of the three OAP's and the dichotomized criterion and each OAP screened out a proportion of the sample that was within the required range of .10 to .60. However, the best selective efficiency was obtained for OAP-15 with a tetrachoric correlation of .59 and a standard error of .23. The proportion of the sample screened out by OAP-15 was .34. Therefore, it is recommended that OAP-15 be used in counseling for the occupation of Jewelry Assembler 6-72.333.